

1010 Rec'd PCT/PTO 19 FEB 2002

FORM PTO-1390  
(REV. 5-93)

U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

6727/OK318US0

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)**

**10/069389**

INTERNATIONAL APPLICATION NO.

INTERNATIONAL FILING DATE

PRIORITY DATE CLAIMED

PCT/IL00/00389

04 July 2000

19 August 1999

TITLE OF INVENTION

**METHOD FOR BREEDING TOMATOES HAVING REDUCED WATER CONTENT AND PRODUCT OF  
THE METHOD**

APPLICANT(S) FOR DO/EO/US

**Arthur SCHAFFER**

Applicant herewith submits to the United States Designated/Elected office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S. C. 371.
3. ☐ This is an express request to begin *national examination procedures* (35 U.S.C. 371 (f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S. C. 371 (b) and PCT Articles 22 and 39 (1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S. C. 371 (c) (2) )
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the *International Bureau*
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☐ A translation of the International Application into English (35 U.S. C. 371 (c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c) (3)).
9. ☒ An unexecuted oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 (with references).
12. ☐ An assignment document for recording. A **separate** cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.  
☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney an/or address letter.
16. ☐ Other items or information:

EXPRESS MAIL CERTIFICATE

Date 2/19/02

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I hereby certify that, on the date indicated above, this paper or fee was deposited with the U.S. Postal Service & that it was addressed for delivery to the Assistant Commissioner for Patents, Washington, DC 20231 by "Express Mail Post Office to Addressee" service.

D B Peck  
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[Signature]  
Signature

U.S. APPLICATION NO. <b>107069389</b> (if known rec. 37 C.F.R. 1.55)		INTERNATIONAL APPLICATION NO.: PCT/IL00/00389		Attorney's Docket Number 6727/OK318USO	
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17. [x] The following fees are submitted:				CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492 (a)(1)-(5)): Search Report has been prepared by the EPO [X] or JPO []				\$890.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) .....				\$710.00	
No international preliminary examination fee paid to USPTO (37 CFR 4.482) but international search fee paid to USPTO (37 CFR 1.445 (a) (2))...				\$740.00	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....				\$1,040.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)....				\$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	16-20	0	0 X \$18.00	\$0.00	
Independent Claims	3-3	0	0 X \$84.00	\$0.00	
Multiple dependent claims(s) (if applicable)			+ 280	\$	
TOTAL OF ABOVE CALCULATIONS =				\$890.00	
Reduction by 1/2 for filing by small entity, if applicable.				\$0.00	
SUBTOTAL =				\$890.00	
Processing fee of \$130.00 for furnishing the English translation later the [ ] 20 [ ] 39 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$890.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). the assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$0.00	
TOTAL FEES ENCLOSED =				\$890.00	
				Amount to be refunded	\$
				charged.	\$

a. [X] A check in the amount of \$890.00 to cover the above fees is enclosed.


b. [ ] Please charge my Deposit Account No.04-0100 in the amount of \$ to cover the above fees.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 04-0100. A duplicate copy of this sheet is enclosed.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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# METHOD FOR BREEDING TOMATOES HAVING REDUCED WATER CONTENT AND PRODUCT OF THE METHOD

## FIELD OF THE INVENTION

The present invention relates to a method for breeding tomatoes having reduced water content and/or with the trait of drying while still attached to the vine, and to tomatoes having reduced water content and to products of the method.

## BACKGROUND OF THE INVENTION

Dehydrated tomato products comprise an important portion of the tomato industry. The production of tomato pastes, ketchup and other processed tomato products is dependent on the energy-requiring steps of dehydration. The production of "sun-dried" tomato products consists of dehydrating cut tomato fruit either in the sun or in drying ovens.

Dry matter content of mature tomato fruit can range from approximately 5-10% (Davies, J.N. and Hobson, G.E. 1981. The constituents of tomato fruit- the influence of environment, nutrition and genotype. CRC Critical Reviews in Food Sci and Nutr. 15:205-280), depending largely on fruit size. Generally, processing tomato cultivars produce mature fruit with a higher water content of approximately approximate 94-95%. Smaller, "cherry"-type tomato fruit, with a fresh weight of 10-20 grams frequently have higher concentration of solids (dry weight) and hence reduced water concentrations of approximately 90% (10% dry weight).

Generally, tomato fruit development stages can be classified as the pre-climacteric stage, which is comprised of the early stages of fruit growth until incipient ripening, the climacteric stage and the post-climacteric or senescent stage. Once the fruit is fully ripe, tissue disorganization occurs, with pathogens contributing to the tissue disorganization, and characteristics associated with "overripening" and subsequent rotting of the fruit become apparent (Grierson, D. and Kader, A.A. 1986. Fruit ripening and quality. In: Atherton, J.G. and Rudich, J. Eds.: The Tomato Crop. Chapman and Hall, London, pp. 241-280).

The production of raisins from grape berries (*Vitis vinifera*) is a well known process in which the dehydration process occurs by diffusion of water through a waxy cuticle (Martin, R.J.L. and Scott, G.L. 1957. The physical factors involved in the drying of Sultana grapes. Australian Journal of Agricultural Research. 8:444-459). For whole grape berries, the drying process is generally assisted by various dipping treatments of the berry, such as the soda-dip method (Nury, F.S., Brekke, J.E. and Bolin, H.R. 1973. Fruits. In: Van Arsdell, W.B., Copley, M.J. and Morgan, A.I., Eds: Food Dehydration. Avi Publishing Co., Westport, Conn. vol. 2,

pp. 158-198). In brief, in this method the berries are dipped in a 0.2- 0.3% solution of caustic soda (sodium hydroxide) at a temperature of about 200°F for a few seconds and are then rinsed with cold water before dehydration. The purpose of the dipping is to modify the berry cuticle so that transpiration of water vapor across the cuticle may proceed at a faster rate.

5 The tomato, like the grape, is botanically classified as a berry and has a waxy cuticle on the fruit epidermis (Baker, E.A., Bukovac, M.J. and Hunt, G.M. 1982. Composition of tomato fruit cuticles as related to fruit growth and development. In: Cutler, D.F., Alvin, K.L. and Price, C.E., Eds: The Plant Cuticle. Academic Press, London. pp. 33-44). However, tomatoes will generally undergo degradation if they remain on the vine after ripening. In the case of  
10 tomatoes, the harvested fruit is generally cut in half in order to increase the dehydration rate. Alternatively, whole fruit may be pierced in order to facilitate fluid movement (Ojimelukwe, P.C. 1994. Effects of processing methods on ascorbic acid retention and sensory characteristics of tomato products. J. Food Sci. Technol. 31:247-248). Drying of the slices or pierced tomato fruit may take place either in the sun or in various forms of drying ovens based on non-solar  
15 energy input.

There are disadvantages to sun-drying since it depends on weather conditions and inclement weather leads to losses. Similarly, there are disadvantages to the use of drying ovens as these are energy consuming. Both sun drying and oven drying may lead to losses in food quality. For example, levels of ascorbic acid, one of the major nutritional contributions of  
20 tomatoes in the human diet, decrease significantly in response to sun-drying or oven-drying (Ojimelukwe, P.C. 1994. Effects of processing methods on ascorbic acid retention and sensory characteristics of tomato products. J. Food Sci. Technol. 31:247-248). Furthermore, the necessity to cut the tomato fruit in half before the drying process does not allow for the production of whole dried tomato fruit.

25 Wild species of the genus *Lycopersicon*, such as *L. hirsutum*, may contain within their genetic makeup expressed characteristics not generally present within the *L. esculentum* species. These genetic traits may be transferred to the cultivated *L. esculentum*. For example, the genetic trait of sucrose accumulation is present in mature fruit of the subgenus *Eriopersicon* (including *L. hirsutum*, *L. chmiliowskii* and *L. peruvianum*) and this trait has been  
30 transferred to *L. esculentum*, using classical genetic breeding techniques, as well as molecular genetic techniques (Schaffer, A.A., Petreikov, M., Miron, D., Fogelman, M., Spiegelman, M., Bnei-Moshe, Z., Shen, S., Granot, D., Hadas, R., Dai, N., Levin, I., Bar, M., Friedman, M., Pilowsky, M., Gilboa, N. and Chen, L. 1999. Modification of carbohydrate content in

developing tomato fruit. Hortscience 34:12-14). The wild species of *Lycopersicon*, however, may also serve as a source of unexpressed genetic traits that can contribute to the value of cultivated plants (Bernacchi, D., Beck-Bunn, T., Eshed, Y., Lopez, J., Petiard, V., Uhlig, J., Zamir, D. and Tanksley, S. 1998. Advanced backcross QTL analysis in tomato. Identification of QTLs for traits of agronomic importance from *Lycopersicon hirsutum*. Theor. Appl. Genet. 97:381-397).

### SUMMARY OF THE INVENTION

The present invention seeks to provide a method for breeding tomatoes having fruit that naturally dehydrate while still attached to the tomato plant and thus have a reduced water content, and to tomatoes having reduced water content and to products of the method.

The development of tomato varieties with the trait of naturally dehydrating while still attached to the vine, without the accompaniment of degradative processes leading to fruit breakdown is highly valuable to the various components of the tomato industry. It can contribute to reduction of processing costs and energy expenditures in the production of pastes, sauces and ketchups. It can contribute to the production of high quality dried and semi-dried (raisin-type) tomato products. It can contribute to the improvement of tomato fruit transport since the volume of transported material will be decreased. It can improve the storage ability of the tomato fruit since reduced water content will be accompanied by increased soluble solids concentration which contributes to the resistance to microbial spoilage.

There is thus provided in accordance with a preferred embodiment of the present invention a method for breeding tomato plants that produce tomatoes with reduced fruit water content including the steps of crossing at least one *Lycopersicon esculentum* plant with a *Lycopersicon* spp. to produce hybrid seed, collecting the first generation of hybrid seeds, growing plants from the first generation of hybrid seeds, pollinating the plants of the most recent hybrid generation, collecting the seeds produced by the most recent hybrid generation, growing plants from the seeds of the most recent hybrid generation, allowing plants to remain on the vine past the point of normal ripening, and screening for reduced fruit water content as indicated by extended preservation of the ripe fruit and wrinkling of the fruit skin.

In accordance with a preferred embodiment of the present invention the steps of pollinating, collecting the seeds, and growing plants are repeated at least once.

Further in accordance with a preferred embodiment of the present invention the step of pollinating includes self pollination.

Still further in accordance with a preferred embodiment of the present invention the step of pollination includes back crossing with a *Lycopersicon esculentum* plant.

Additionally in accordance with a preferred embodiment of the present invention the *Lycopersicon* spp plant is a *Lycopersicon hirsutum* plant.

5 In accordance with a preferred embodiment of the present invention the method additionally includes the steps of crossing plants derived from hybrid seeds whose progeny show reduced fruit water content with a *Lycopersicon* plant, growing the crossed plants, and selecting plants with tomato fruits having an increased dry weight percentage as compared to fruit from a non-crossed *Lycopersicon*. The steps of crossing and selecting may be repeated at  
10 least once. The crossing may include sexual or asexual crossing. The asexual crossing may include somatic cell hybridization.

Further in accordance with a preferred embodiment of the present invention the method additionally includes the step of propagating the plants with tomato fruits having the desired characteristics. The step of propagating may include vegetative propagation or propagation by  
15 seed.

In accordance with a preferred embodiment of the present invention the method additionally includes the steps of crossing plants derived from hybrid seeds whose progeny show reduced fruit water content with a *Lycopersicon* plant, growing the crossed plants, harvesting ripe tomato fruits before signs of dehydration thereof, and allowing the fruits to  
20 dehydrate after removal from the plant.

There is also provided in accordance with a preferred embodiment of the present invention a tomato fruit characterized by a capability of natural dehydration while on a tomato plant, natural dehydration being defined as wrinkling of skin of the tomato fruit when the fruit is allowed to remain on the plant after a normal ripe harvest stage, the natural dehydration  
25 being generally unaccompanied by microbial spoilage.

There is also provided in accordance with a preferred embodiment of the present invention a tomato fruit characterized by an untreated skin which permits dehydration of the fruit so as to obtain wrinkling of the skin, the dehydration being generally unaccompanied by microbial spoilage.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is now made to a method for breeding tomatoes having fruit that naturally dehydrate while still attached to the tomato plant and reduced water content.

The method for breeding tomato plants includes first hybridizing at least one *Lycopersicon esculentum* plant with a wild *Lycopersicon* spp. plant. The fruits of the *L. esculentum* plants are then allowed to ripen and the hybrid (F<sub>1</sub>) seeds are collected. The collected F<sub>1</sub> seeds are then planted and F<sub>1</sub> plants are grown and allowed to self-pollinate. Selfing may be continued for at least one additional generation or the F<sub>1</sub> plants may be crossed to a *L. esculentum* parental plant. Fruits from selfed or backcrossed generations are allowed to remain on the vine past the point of normal ripening, as determined by change of fruit color, and screened for the presence of natural dehydration. Natural dehydration, or reduced water content, is indicated by the wrinkling of the fruit skin when the fruit is allowed to remain on the vine after the normal red ripe harvest stage.

Plants from any of the selfed generations may be propagated for use by vegetative propagation methods such as micropropagation or by sexual propagation methods. The plants may also be crossed with other *L. esculentum* cultivars to create varieties that incorporate characteristics other than reduced fruit water content. The varieties may then be propagated by vegetative or sexual propagation methods.

Plants from any of the selfed generations may also be back crossed to *L. esculentum* for at least one generation. The fruits of the last back cross generation are allowed to remain on the vine past the normal point of ripening. The appearance of dehydration as evidenced by wrinkling of the fruit skin indicates reduced water content in the fruit. Plants selected for this trait may then be propagated either vegetatively or by seed based propagation. Selected plants may then also be crossed with other *L. esculentum* cultivars to create varieties that incorporate characteristics other than reduced fruit water content. The varieties may then also be propagated by vegetative or sexual propagation methods.

Reference is now made to the following example that illustrates the invention.

## Example 1

Plants of the *L. esculentum* breeding line 1630 (a Volcani Institute male sterile breeding line, used to simplify the production of the interspecific hybrid) were pollinated with pollen of the wild species *L. hirsutum* (LA1777). Hybrid F<sub>1</sub> plants were grown and allowed to self-pollinate, generating F<sub>2</sub> seed. F<sub>2</sub> seed were sown and about 350 plants were grown in a screenhouse and allowed to self-pollinate. Ripe fruit from each individual plant that produced

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fruit were individually analyzed for soluble solids (refractometrically) to insure the lines also included the characteristic of high soluble solids. Only 25 of the interspecific F2 plants freely produced fruit. Three F2 plants were selected based on their high sugar content (Brix in excess of 10) when ripe. For example, fruit of F2-82 had 71 mg soluble sugar, composed of sucrose, glucose and fructose, per gram fresh weight of fruit, as determined by the method described herein below. F3 seeds were sown and ten plants of each of the F3 plants of these three F2 selections (termed F2-24, F2-82 and F2-134) were grown, and fruit was allowed to remain on the vine past the normal stage of ripening and harvest. Fruit from these F3 plants were generally yellow when ripe and did not turn red even after the normal ripening stage. Among the F3 plants one plant (F3-203-10, derived from F2-134) showed the characteristic of signs of fruit dehydration, evidenced by wrinkling of the fruit skin.

A pedigree breeding program was developed to obtain tomatoes with reduced water content using as a selection system signs of fruit dehydration as evidenced by wrinkling of the fruit skin after the red ripe stage. This breeding strategy consisted of selfing F3-203-10 until the F4 generation and backcrossing to *L. esculentum* breeding line L-27, with the product of this cross being selfed for four additional generations to produce the BC1F4 population. Lines of this population (lines 901 and 903) as well as hybrid plants derived from crosses between this population and commercial tomato cultivars (cv. F139 and cv. BR124) produced plants that all showed the trait of fruit dehydration as evidenced by wrinkling of the ripe fruit skin. The presence of the trait in the hybrid plants indicates that the trait is heritable, governed by dominant genetic factors, and can be selected for in the early generations of the breeding program.

#### Example 2

Pollen from one plant (F2-82) which was characterized by high soluble sugar level in the mature fruit (71 mg soluble sugar, composed of sucrose, glucose and fructose, per gram fresh weight of fruit) was used to pollinate two standard, industry type tomatoes (breeding lines A701 and 699) for the production of two backcross-F1 (BC-F1) populations. One-hundred BC-F2 plants from each of the two hybrids were grown and the presence of signs of fruit dehydration, evidenced by wrinkling of the fruit skin, were seen in fruit of plants from these F2 populations. This shows that even at early stages of a selection program, the trait can be selected for without large populations of plants.

#### Experiment 3



Fruit of progeny of advanced lines derived from the lines described in experiment 1, that showed the characteristic to dehydrate on the vine, as evidenced by the wrinkling of the fruit were harvested and the juice pressed and Brix of the expressed juice was measured by a digital refractometer (Atago model X-1). The following table shows characteristic Brix values of some of the partially dehydrated tomato fruit (cherry size, approx. 15 g). Fruit were harvested when partially wrinkled but not fully dehydrated. The results of this experiment indicate that the trait of fruit dehydration and increase in Brix value is a selectable inherited trait. The parental selection (self of 1465-3) was partially dehydrated as was the F1 hybrid between 1465-3 and the cherry cultivar F139. This indicates that the trait is at least partially dominant in its inheritance pattern. Similarly, 3 representative plant selections from the F2 population (1730) derived from the self of the F1 (1465-3 x F139) which showed the trait of fruit wrinkling are presented and indicates that the selection method can be used in the segregating F2 population.

Table 1: Brix values of partially dehydrated tomato fruit, harvested from the vine at the stage when fruit wrinkling was visually observable. Fruit size was of the cherry-tomato size (approx. 10-15 gr).

	tomato plant	cross	generation	Brix
20	1630-1+2	1465-3 self	BC2F2	19.2
	1631-1	1465-3 x cv. 139	BC3F1	17.4
	1730-3	1631-2 self	BC3F2	22.4
	1730-4	1631-2 self	BC3F2	29.0
	1730-5	1631-2 self	BC3F2	11.1

25

#### Experiment 4

In an experiment to determine whether the dehydration process can take place after removal from the vine, red ripe fruits from a BCF3 population were harvested, as above, and allowed to remain and dehydrate on netted screens on the laboratory bench without temperature control. After approximately one month the fruit had reached 86.2% dry weight, and were generally unaccompanied by microbial spoilage. Percent dry weight was calculated as the percentage of weight after drying in a forced air oven at 60°C for 24 overnight, compared

to the weight of fruit prior to oven drying. Ten representative fruit were used to calculate the percent dry weight.

Such fruit has been maintained for over a year at 5°C and at room temperature in an uncontrolled environment for at least 5 months, without further decay. The results of these experiments indicate that the dehydrated fruit may be harvested at various stages of dehydration (even before dehydration commences) and that dehydration of the fruit may also continue after detachment from the vine.

#### Experiment 5

In order to characterize the development of the dehydration process an experiment was carried out in which 14 red-ripe fruit from plants which showed the trait of dehydration of the fruit, but which themselves had not yet reached the dehydration stage, were selected. Seven of these fruit were harvested when red-ripe and analyzed immediately, as described below. The other seven fruit were allowed to remain attached to the vine for an additional 14 days and, when fruit wrinkling was observed, were analyzed, as follows.

Each fruit was individually weighed, a sample of the fruit juice was tested by refractometer, for Brix value. An additional sample of each fruit was weighed fresh and then dried in an oven, as described above, for the calculation of percent dry weight. A third portion of each fruit was used for the analysis of individual soluble sugar levels, as follows.

Individual fruits were harvested and a portion of the fruit pericarp was placed in 80% ethyl alcohol and heated to 70°C in order to stop enzymatic activity and extract the soluble sugars. Soluble sugars were extracted three times in successive changes of 80% alcohol which was then evaporated.

The sugars were then dissolved in double distilled water, centrifuged at 5,000 rpm in an eppendorf centrifuge tube for 15 minutes to remove cell debris and 0.5 ml aliquot passed through a 0.45 micron filter in preparation for high Pressure Liquid Chromatography (HPLC) analysis. HPLC analysis was performed using a BioRad (Richmond, CA, USA) Fast Carbohydrate column for the separation of glucose, fructose and sucrose according to the manufacturer's instructions. The sugars were identified and quantified according to chromatographic behavior of standards for the sugars which were obtained from Sigma (St. Louis, MO, USA).

The results of this study are shown in Table 2 and show that the wrinkling phenomenon is accompanied by loss of water from the fruit, leading to an increase in % dry weight, an increases in Brix and individual sugar concentrations. The dry matter per fruit remains

approximately the same. This indicated that the phenomenon of fruit wrinkling, and the concomitant increase in sugar concentration and in dry matter concentration is primarily one of natural dehydration of the fruit, without a concomitant loss of fruit dry matter content.

5 Table 2:

<u>Trait</u>	<u>Red ripe</u>	<u>Wrinkled</u>
Fresh weight (g/fruit)	16.63	12.20
Percent dry weight	12.53	17.89
Brix	11.51	14.57
10 Sugars (mg/gm fr w)		
Total	66.4	86.4
Sucrose	3.8	6.1
Glucose	30.5	38.4
Fructose	32.1	41.9
15		
Water content (g/fruit)	14.55	10.02
Dry weight (g/fruit)	2.08	2.18
Sugars (g/fruit)	1.10	1.05

20 In summary, with the methods of the present invention, a tomato fruit can be obtained characterized by an untreated skin which permits dehydration of the fruit so as to obtain wrinkling of the skin, wherein the dehydration is generally unaccompanied by microbial spoilage. In another aspect of the invention, a tomato fruit can be obtained characterized by a capability of natural dehydration while on a tomato plant, natural dehydration being defined as  
 25 wrinkling of skin of the tomato fruit when the fruit is allowed to remain on the plant after a normal ripe harvest stage, wherein the natural dehydration is generally unaccompanied by microbial spoilage.

Alternatively, it is noted that the tomato fruit can be treated with a substance, such as sulfur dioxide, to help retain skin color during and after dehydration, such as is done with dried  
 30 fruits such as raisins.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described herein above. Rather the scope of the present invention is defined only by the claims which follow:

10  
CLAIMS

What is claimed is:

1. A method for breeding tomato plants that produce tomatoes with reduced fruit water content comprising the steps of:
  - 5 crossing at least one *Lycopersicon esculentum* plant with a *Lycopersicon* spp. to produce hybrid seed;
  - collecting the first generation of hybrid seeds;
  - growing plants from the first generation of hybrid seeds;
  - pollinating the plants of the most recent hybrid generation;
  - 10 collecting the seeds produced by the most recent hybrid generation;
  - growing plants from the seeds of the most recent hybrid generation;
  - allowing plants to remain on the vine past the point of normal ripening; and
  - screening for reduced fruit water content as indicated by extended preservation of the ripe fruit and wrinkling of the fruit skin.
- 15 2. The method according to claim 1 wherein the steps of pollinating, collecting the seeds, and growing plants are repeated at least once.
3. The method according to claim 1 wherein the step of pollinating includes self pollination.
4. The method according to claim 1 wherein the step of pollination includes back crossing  
20 with a *Lycopersicon esculentum* plant.
5. The method according to claim 1 wherein the *Lycopersicon* spp plant is a *Lycopersicon hirsutum* plant.
6. The method according to claim 1 and additionally comprising the steps of:
  - crossing plants derived from hybrid seeds whose progeny show reduced fruit water  
25 content with a *Lycopersicon* plant;
  - growing the crossed plants; and
  - selecting plants with tomato fruits having an increased dry weight percentage as compared to fruit from a non-crossed *Lycopersicon*.
7. The method according to claim 6 wherein the steps of crossing and selecting are  
30 repeated at least once.
8. The method according to claims 1 wherein said crossing includes sexual crossing.
9. The method according to claims 1 wherein said crossing includes asexual crossing.

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10. The method according to claim 9 wherein said asexual crossing includes somatic cell hybridization.

11. The method according to claim 1 and additionally comprising the step of propagating the plants with tomato fruits having the desired characteristics.

5 12. The method according to claim 11 wherein the step of propagating includes the step of vegetative propagation.

13. The method according to claim 11 wherein the step of propagating includes the step of propagation by seed.

10 14. The method according to claim 1 and additionally comprising the steps of:  
crossing plants derived from hybrid seeds whose progeny show reduced fruit water content with a *Lycopersicon* plant;  
growing the crossed plants;  
harvesting ripe tomato fruits before signs of dehydration thereof; and  
allowing the fruits to dehydrate after removal from the plant.

15 15. A tomato fruit characterized by a capability of natural dehydration while on a tomato plant, natural dehydration being defined as wrinkling of skin of the tomato fruit when the fruit is allowed to remain on the plant after a normal ripe harvest stage, said natural dehydration being generally unaccompanied by microbial spoilage.

20 16. A tomato fruit characterized by an untreated skin which permits dehydration of the fruit so as to obtain wrinkling of the skin, said dehydration being generally unaccompanied by microbial spoilage.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
1 March 2001 (01.03.2001)

PCT

(10) International Publication Number  
**WO 01/13708 A1**

- (51) International Patent Classification<sup>7</sup>: A01H 5/10, 1/04
- (21) International Application Number: PCT/IL00/00389
- (22) International Filing Date: 4 July 2000 (04.07.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
131509 19 August 1999 (19.08.1999) IL
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- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— With international search report.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.



WO 01/13708 A1

(54) Title: METHOD FOR BREEDING TOMATOES HAVING REDUCED WATER CONTENT AND PRODUCT OF THE METHOD

(57) Abstract: A method for breeding tomato plants that produce tomatoes with reduced fruit water content including the steps of crossing at least one *Lycopersicon esculentum* plant with a *Lycopersicon* spp. to produce hybrid seed, collecting the first generation of hybrid seeds, growing plants from the first generation of hybrid seeds, pollinating the plants of the most recent hybrid generation, collecting the seeds produced by the most recent hybrid generation, growing plants from the seeds of the most recent hybrid generation, allowing plants to remain on the vine past the point of normal ripening, and screening for reduced fruit water content as indicated by extended preservation of the ripe fruit and wrinkling of the fruit skin.

<b>COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY</b> <small>(Includes Reference to PCT International Applications)</small>	<b>ATTORNEY DOCKET NUMBER</b> 6727/OK318US0
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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed for and which a patent is sought on the invention entitled

## METHOD FOR BREEDING TOMATOES HAVING REDUCED WATER CONTENT AND PRODUCT OF THE METHOD

the specification of which (check only one item below)

- ☐ is attached hereto
- ☐ was filed as United States application
- Serial No \_\_\_\_\_
- on \_\_\_\_\_
- and was amended
- on \_\_\_\_\_ (if applicable).

- ☒ was filed as PCT international application
- Number PCT/IL00/00389
- on 04 July 2000
- and was amended under PCT Article 19
- on \_\_\_\_\_ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims as amended by any amendment referred to above

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:			
COUNTRY <small>(if PCT indicate PCT)</small>	APPLICATION NUMBER	DATE OF FILING <small>(day, month, year)</small>	PRIORITY CLAIMED <small>UNDER 35 U.S.C. 119</small>
Israel	131509	August 19, 1999	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

Combined Declaration for Patent Application and Power of Attorney (Continued)  
(Includes Reference to PCT International Applications)

ATTY'S DOCKET NUMBER  
6727/OK318

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBER ASSIGNED (if any)		

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. Morris Relson #15,108, Gordon D. Coplein #19,165, William F. Dudine, Jr. #20,569, Michael J. Sweedler #19,937, S. Peter Ludwig #25,351, Paul Fields #20,298, Joseph B. Lerch #26,936, Melvin C. Garner #26,272, Ethan Horwitz #27,646, Beverly B. Goodwin #28,417, Adda C. Gogoris #29,714, Martin E. Goldstein #20,869, Bert J. Lewen #19,407, Henry Sternberg #22,408, Peter C. Schechter #31,662, Robert Schaffer #31,194, Robert C. Sullivan, Jr. #30,499, and Joseph R. Robinson #33,448

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	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
202	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
203	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
204	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
205	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
206	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
207	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 7/5/02	DATE	DATE